HUMAN FACTORS ASSESSMENT OF THE TELIDON AVIATION BRIEFING SYSTEM (TABS): STUDY OF PILOT PERFORMANCE

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Table of Contents

1.0 Executive Summary 1

2.0 Introduction 4

3.0 Method 9
3.1 Subjects 9
3.2 Materials and apparatus 9
3.3 Design 10
3.4 Procedure 11

4.0 Results 13
4.1 Sample profile 13
4.2 Go/no go decision 13
4.3 Performance on the detailed weather test 14
4.4 Time taken to obtain a weather briefing 15
4.5 Role of expertise and experience with TABS 16

5.0 Discussion 18
5.1 Length of briefings 18
5.2 Frequency of TABS use 18
5.3 Explanation of the experimental findings 19
5.4 Alternative explanations of the experimental findings . 19

6.0 Summary and future considerations 23

7.0 References 26

List of Tables and Figures

Schematic diagram of self-briefing as provided by the Telidon Aviation Briefing System 7

Schematic diagram of telephone briefing as provided by staff of Atmospheric Environment Service and Flight Service Stations . 8

Comparison of Participants in Experiment with 1983 Transport Canada Statistics 27

Comparison of Aircraft Used by Pilots in Experiment with 1983 Transport Canada Statistics 28

Go/No Go Decision as a Function of Weather Day and Type of Briefing. 29

Performance on Weather Information Test Against Weather Day and Type of Briefing 30

Average Performance Scores for TABS and Tailored Briefings for each Question 31

Time Taken to Obtain a Weather Briefing as a Function of Weather Day and Type of Briefing 32

Performance on Weather Information Test as a Function of Expertise and Frequency of TABS Use in the TABS Briefing Condition . . . 33

1.0 Executive Summary

This study is part of a human factors assessment of TABS conducted during a two-year trial in selected southern Ontario airports. A modified version of TABS is currently available and additional changes are being planned. Pilots brief themselves about the weather with TABS by using a terminal linked to a central computer. TABS was introduced to supplement services that provide access to expert briefers.

Other components of this human factors assessment are a background report and a survey of TABS users. Key findings are included in a summary report that also provides recommendations related to future planning for TABS.

The current experiment investigated in a controlled situation to what extent pilots can use TABS to make good, informed decisions as compared to pilots who use audio-taped briefings that are tailored to their needs.

Specifically, the experiment examined to what extent pilots make appropriate go/no go decisions, and have the detailed information necessary for planning and carrying out a flight after receiving either a tailored or a TABS briefing. The experiment also investigated how long it takes pilots to obtain this information and whether performance after using TABS was affected by the nature of the weather conditions.

A total of 40 pilots participated in the experiment. The pilots had a wide range of flying skills and had used TABS at least five times. Each pilot was given a single briefing describing the weather conditions on 1 of the 4 days used in the experiment. The same days were used in both briefing conditions. Half the pilots briefed themselves using a

simulated TABS system. The other half received a tailored briefing which was based on information available from the simulated TABS system and was presented using audiotape.

The weather on these days varied from a straightforward VFR condition, to a marginal VFR condition, to a day unacceptable for a VFR flight. (VFR, visual flight rules, call for skies that are clear enough to fly without the use of instruments.) The differences discussed below are statistically significant unless otherwise indicated.

In making a go/no go decision, pilots in both the TABS and tailored briefing conditions were able to make decisions that agreed reasonably well with the decisions of experts for all weather conditions tested in the experiment.

However, when asked a series of basic aviation weather questions related to their flight, pilots in the TABS condition had substantially less detailed information relevant to a hypothetical, itinerant flight than pilots in the tailored condition. This difference was observed for all types of weather conditions and for many different types of information.

Pilots using the simulated TABS system also took substantially longer to brief themselves than pilots in the tailored briefing condition. This result was obtained for all weather days.

In a follow-up to the study, it was determined that pilots, on average, understand 88% of the information on SA/FT pages. SA/FT pages present, in abbreviated form, the most up-to-date and detailed information about weather conditions at airports. Requests for these pages constitute approximately one third of all page requests made on TABS.

The report concludes tentatively that pilots using TABS may make reasonably effective go/no go decisions, but they may not have all the detailed information they require to effectively plan or execute their flight. It is proposed that TABS users may have difficulty in selecting and/or remembering information relevant to their intended flight. This explanation leads to a discussion of the potential benefits of tailored briefings as a TABS option, paper copies of TABS information pages as a memory aid and computer-assisted instruction in the use of TABS.

2.0 Introduction

To fly safely, pilots need accurate, up-to-date aviation and weather information and must be able to use this information effectively to make good, informed decisions. Without accurate knowledge of the weather, pilots may unintentionally fly into dangerous weather conditions. The objective of this experiment is to learn how effectively pilots can use information they get from TABS.

This study is part of a human factors assessment of TABS conducted during a two-year trial in selected southern Ontario airports. A modified version of TABS is currently available and additional changes are being planned. Pilots brief themselves about the weather with TABS by using a terminal linked to a central computer. TABS was introduced to supplement services that provide access to expert briefers.

Other components of this human factors assessment are a background report and a survey of TABS users. Key findings are included in a summary report that also provides recommendations related to future planning for TABS.

Figure 1 (page 7) illustrates how TABS lets pilots obtain information directly from a user aviation weather database. By contrast, a pilot who calls the telephone services (Figure 2, page 8) talks to a briefer who retrieves needed information from a database and makes a presentation that is tailored to the pilot's specific requirements. With the telephone services, the briefer uses his own knowledge and expertise to decide what information is relevant to a particular flight and to explain its implications to the pilot. With TABS, the pilot must select and interpret this information on his own.

To compare different types of briefing, half the pilots in the experiment heard an audiotape of a tailored briefing prepared by a briefer from Transport Canada that described the relevant weather conditions for a pilot planning to fly from North Bay to London, Ontario, in a small aircraft. The other half of the pilots used a microcomputer-based system that simulated TABS.

The information used by the briefers and by the pilots was identical; briefers prepared their briefings by using the simulated TABS system.

The effect of the type of briefing on pilot performance was investigated by assessing how well pilots decide whether to make a flight and to what extent they have the detailed information necessary to plan a flight. These tasks were selected in part because pilots often use weather information systems for these reasons and also because of the safety implications. Pilots who do not make informed go/no go decisions or who fly with an inadequate understanding of weather conditions may risk their own and other people's safety.

The experiment also investigated whether the type of briefing affects how long it takes to be briefed.

Finally, the experiment investigated whether pilots' effectiveness in using these briefing services was influenced by the weather conditions being described. Weather conditions from four different days were selected. There were VFR conditions for two of the days, marginal VFR conditions for one day, and weather conditions unsuitable for a VFR flight on one day. (VFR, visual flight rules, call for skies that are clear enough to fly without the use of instruments.)

The general procedure of the experiment was to test pilots individually. Pilots were asked to use a weather information system supplied to them (either an audiotape recording of a tailored briefing or a simulated TABS system) to make a go/no go decision and to plan a hypothetical flight between North Bay and London, Ontario. After pilots were briefed, the briefing system was removed and pilots were asked a number of detailed questions relevant to the planned flight.

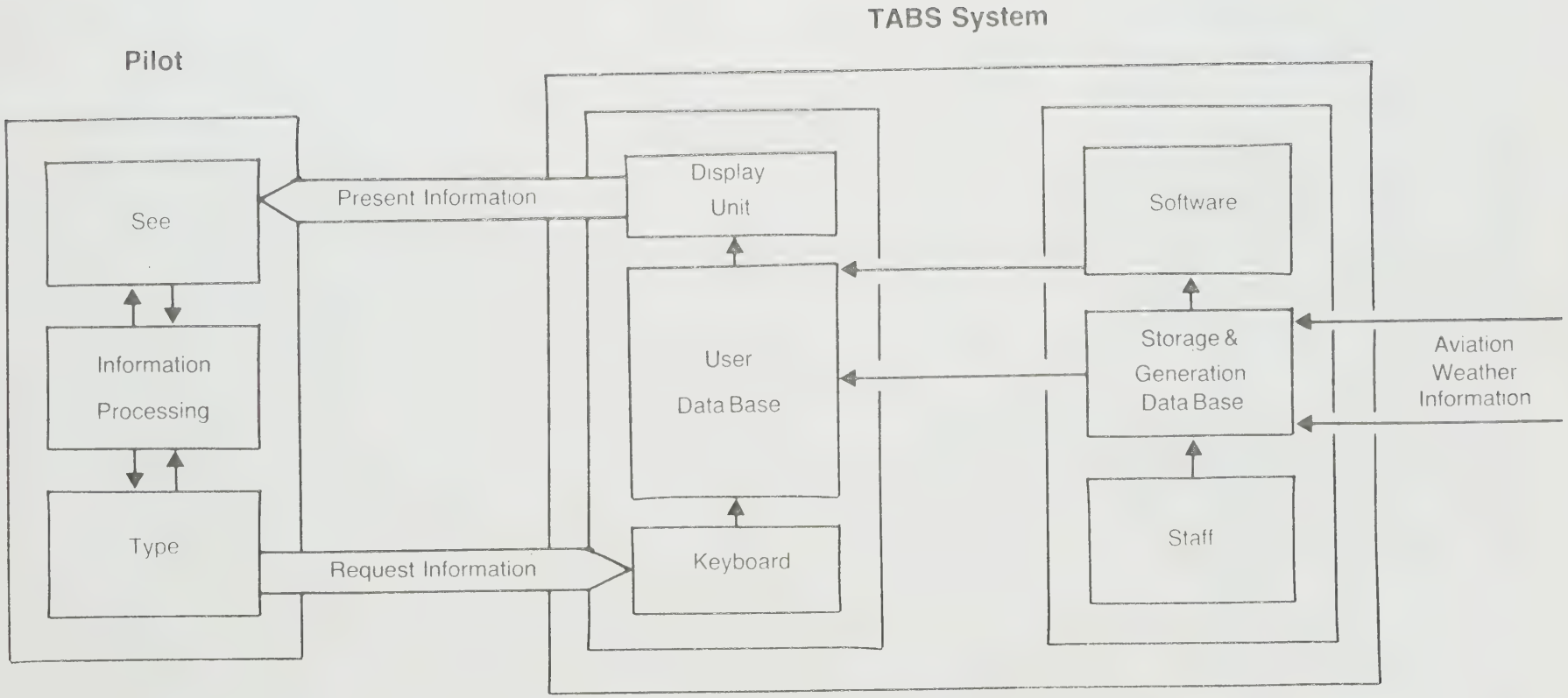

Figure 1. Schematic diagram of self-briefing as provided by the Telidon Aviation Briefing System.

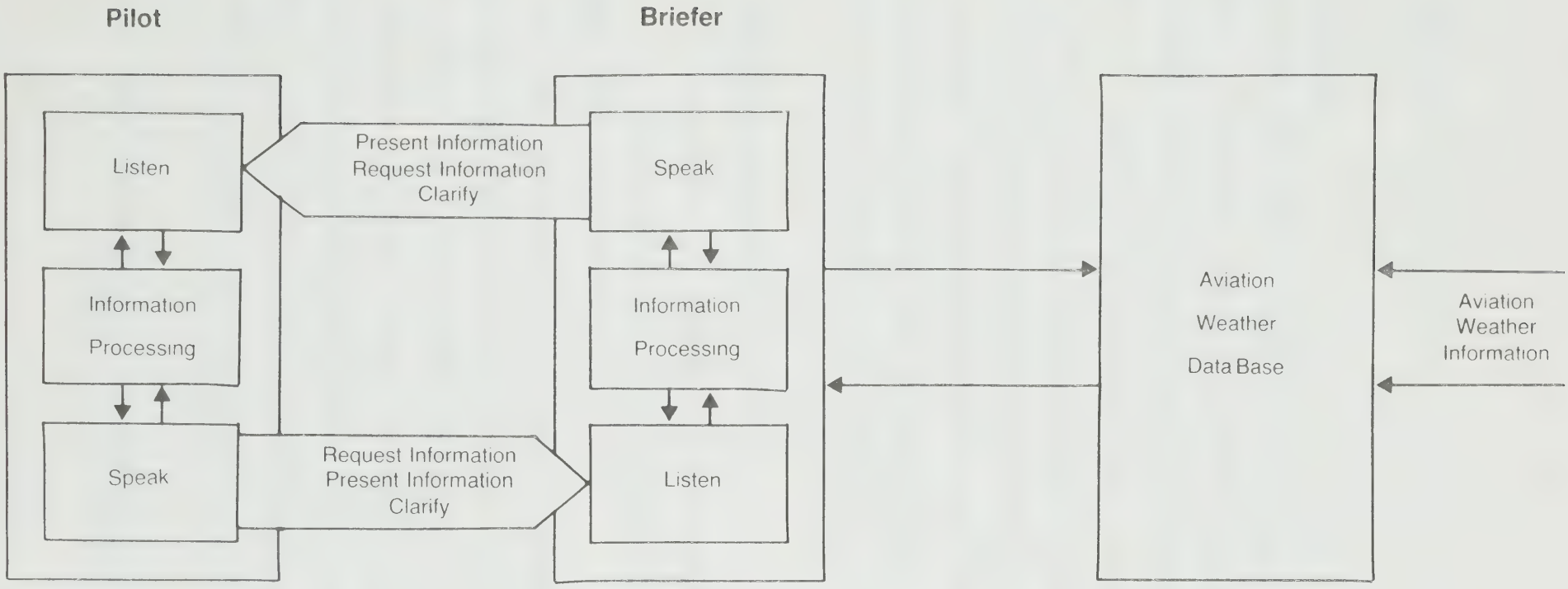

Figure 2. Schematic diagram of telephone briefing as provided by staff of Atmospheric Environment Service and Flight Service Stations.

3.0 Method

3.1 Subjects

A total of 40 pilots participated in the experiment. They were recruited at Brampton, Buttonville, and Maple airports in southern Ontario. In order to participate in this experiment pilots needed to have at least a student pilot permit and must have used TABS five times or more. This latter condition was imposed because the focus in this study is on the performance of pilots who are reasonably familiar with TABS. Results from a previous study that surveyed users suggest that most respondents did not find it difficult to learn to use TABS and that pilots should be reasonably familiar with TABS if they have used it five times or more.

3.2 Materials and apparatus

The aviation and weather information used in the experiment was taken from four days and was prepared for use in two different briefing conditions (TABS and tailored).

TABS pages were copied onto an IBM PC, organized using PC/Videotex software and displayed on a 24 by 18 cm color video monitor. The entire system simulated closely the appearance and operation of TABS.

Tailored briefings were created by having briefers from Transport Canada read the description of the hypothetical flight, familiarize themselves with the weather conditions using only the simulated TABS system and then prepare a tailored briefing and read it aloud into a tape recorder.

There are similarities and differences between the tailored

briefing used in the experiment and the telephone briefings offered by AES and FSS to pilots. In both types of briefing, professionally trained presentation technicians deliver briefings that are tailored to meet the specific needs of the pilot and intended flight. One difference is that in the tailored briefings there is no opportunity for pilots and briefers to interact as they can over the telephone. One consequence of this difference is that these tailored briefings are not adjusted to the meterological expertise of the pilot being briefed. A second difference is that the tailored briefing on tape appears to be somewhat longer and perhaps more detailed than a typical briefing over the telephone. The tailored briefings on tape averaged about 7 minutes in length, whereas a typical briefing over the telephone takes about 5 minutes.

The actual aviation and weather information from TABS were used in the experiment. The information came from October 18, October 25, October 30, and November 25, 1985. These days were selected because they represented different weather conditions. For two of the days weather conditions were relatively straightforward and there were VFR flying conditions. On one day there was a complex weather system and the flying was marginal VFR, and on the fourth day weather conditions were unsuitable for VFR flight.

Detailed questions tested how well pilots knew information relevant to the flight. Many of these questions were derived from an examination of the Aviation Weather Information Services Briefing Guide (Transport Canada, 1981). The questions are outlined in Table 5.

3.3 Design

The experimental design presented pilots with all possible combinations of the following two factors: type of briefing (tailored or TABS); and weather day (1 to 4). A total of 40 pilots participated in the experiment. Each pilot received a single briefing. Half the pilots were given a TABS briefing and the other half a tailored briefing. Thus five pilots in each briefing condition were given the weather information for each day.

3.4 Procedure

Pilots were tested individually. Before each session began, the pilot was told the general purpose of the experiment and asked to sign a consent form. Then the pilot was given a brief questionnaire which asked about his background, his experience as a pilot (license type, hours flown, etc.), his meteorological training, and the number of times he had used TABS.

Then the pilot was given a description of a hypothetical flight from North Bay to London, Ontario, in a small aircraft equipped for VFR flight only. The description of the planned flight and aircraft was the same for all pilots.

Pilots were asked to use a weather briefing system (an audiotape recording of a tailored briefing or a simulated TABS system) to make a go/no go decision and then (regardless of the first judgment) to obtain all the information necessary to plan the flight.

Pilots were told to take as much time as they wanted to review the material. In the tailored briefing condition pilots could stop, start, and rewind the tape. In the TABS condition, pilots could access any

available page as often as they wanted. In addition, pilots could examine a detailed aviation map to estimate distances, plot routes, learn about the terrain along the proposed route, and so on. Information related to patterns of system use were not recorded.

When the pilot indicated that he had finished, the briefing system was removed and he was asked a series of detailed questions about the weather and aviation conditions expected during the planned flight. The pilot was given as much time as he needed to answer the questions.

Upon completion of the experiment, $5.00 was paid to the pilot.

4.0 Results

4.1 Sample profile

The sample of pilots used in this study was compared with the population of pilots in Canada as described in 1983 Transport Canada statistics. Table 1 shows that pilots in the sample are significantly younger and better qualified. Table 2 shows that sample pilots are significantly more likely to fly lighter piston-powered aircraft.

Differences between the Transport Canada and experimental profiles are most likely attributable to the fact that pilots in the experiment were recruited at airports and for that reason are more likely to be frequent fliers, whereas the Transport Canada statistics are as likely to include a frequent flier as an infrequent one. In addition, the survey did not seek out professional pilots flying larger or jet-powered aircraft because TABS was not designed for these users.

Results indicated that many pilots in the experiment were frequent users of TABS. About 50% of the pilots in the experiment had used TABS more than 40 times and 75% had used TABS more than 10 times. However, pilots in the tailored and TABS briefing conditions did not differ significantly in the number of times they had used TABS ($t(38) = 0.01$, n.s.) or in their expertise as pilots ($t(38) = 0.13$, n.s.).

4.2 Go/no go decision

Table 3 shows the go/no go decisions made by pilots in terms of weather day and the type of briefing they received. Pilots were asked to use the following four-point scale to indicate whether or not they would fly that

day: definitely not fly (1); probably not (2); probably would (3); and most definitely would (4).

Results indicate that after either a simulated TABS or a tailored briefing, pilots are aware of general weather conditions on the different days and make appropriate go/no go decisions. On day 1, the average rating in the TABS (1.4) and tailored (1.6) conditions indicate that most pilots would definitely not fly, a judgement shared by our experts. On days 2 and 3, pilots in both briefing conditions strongly indicated that they would fly, a judgement also made by our experts. On day 4, pilots indicated that the weather was marginal (TABS (2.4) and tailored (2.8)) and that on average the pilots would not fly. Once again this result is consistent with our experts, who indicated that the weather was marginal and that they probably would not fly.

Results from an analysis of variance are shown at the bottom of Table 3, and confirm the above description of the findings. There was a significant effect of weather day ($F(3,32) = 12.49$, $p < 0.001$), but no significant effect of type of briefing ($F(1,32) = 0.57$, n.s.) or weather times briefing interaction ($F(3,32) = 0.29$, n.s.).

4.3 Performance on the detailed weather test

Table 4 shows the performance of pilots on the detailed weather test in terms of the weather day seen and the type of briefing they received. Results indicate that performance in the tailored briefing condition (0.70) was substantially higher than in the TABS condition (0.40). This difference is statistically significant and not affected by weather day.

Table 5 shows the average performance scores for TABS and tailored

briefings for each question asked in the detailed weather test. The left-most column summarizes the questions asked; the next three columns present the average score obtained in the TABS condition, the tailored condition, and the total score possible for that question; the two right-most columns contain the value obtained in a t-test, and the statistical significance of that test.

Results show that the higher performance in the tailored condition is a general effect and is obtained for most questions. For 10 of the 12 questions, scores were higher in the tailored condition; and 7 of these were significantly higher as measured by a t-test. For no question was performance statistically higher in the TABS condition.

4.4 Time taken to obtain a weather briefing

Table 6 presents the briefing time for each of the different weather days and types of briefing. Briefing time measures the time pilots had access to the briefing system. Although much of this time was spent using the briefing system, pilots also spent time examining the detailed weather map to plot their route, measure distances, and so on.

Results indicate that for each weather day more time is spent in the TABS condition than the tailored condition. On average, pilots take 29.8 minutes in the TABS condition, but 17.4 minutes in the tailored condition. This difference is statistically significant, ($F(1,32) = 12.24$, $p < 0.001$).

Results of the analysis of variance are shown at the bottom of Table 6 and confirm the above description of these findings. There is no significant effect of weather day ($F(3,32)$, n.s.) and no significant

briefing times weather day interaction ($F(3,32) = 0.01$, n.s.).

4.5 Role of expertise and experience with TABS

To examine the role of expertise on performance in this experiment, a single index of expertise was computed for each pilot. This indicator, used in the TABS User Survey as well, takes into consideration the license type of the pilot, the pilot's training in aviation meteorology, and self-rated meteorological expertise.

This index was then correlated with performance on the detailed weather test. In the tailored condition, the Pearson correlation coefficient (r) was 0.424 and approached statistical significance, but in the TABS condition (r) was 0.053 and was not significant. Thus, although better performance appears to be weakly associated with more expertise in the tailored condition, there seems to be no relation between performance and expertise in the TABS condition.

To examine the possibility that high performance on the detailed weather test in the TABS briefing condition requires experience using TABS in addition to expertise, the 20 pilots in the TABS condition were divided into 4 groups consisting of high and low expertise pilots who were either high or low frequency users of TABS. The scores of each of the four groups on the detailed weather tests are shown in Table 7.

These results do not provide support for the hypothesis that, in the TABS condition, performance by more expert and more frequent users of TABS is higher than for other users. An analysis of variance confirms that there is no significant effect of frequency of using TABS ($F(1,16) = 0.87$, n.s.), no effect of expertise ($F(1,16) = 0.01$, n.s.), and no

significant frequency times expertise interaction ($F(1,16) = 0.02$, n.s.).

Further examination of the frequency of use variable suggests that, in the TABS condition, frequent users of TABS tend to spend less time getting briefed ($r = -0.351$) although this result was not statistically significant, possibly because of the small numbers of subjects in this experiment.

5.0 Discussion

5.1 Length of briefings

It was found that briefing time is longer in the TABS condition (29.8 minutes) than in the tailored condition (17.4 minutes). This result is consistent with results from the TABS User Survey in which pilots indicated that a briefing from TABS takes longer than a telephone briefing. Among the possible reasons for the differences are the time it takes for pages to be displayed on the screen and the time it takes pilots to sift through the information to identify what is relevant to the particular flight and to interpret that information.

It is not possible to conclude definitely to what extent each of these factors contributed to the additional time it took to get briefed using TABS. However, it is our impression that pilots spent a great deal of time deciding what information they needed and then interpreting that information. That is, they spend a great deal of time performing functions that briefers have done in the tailored briefing condition.

5.2 Frequency of TABS use

It was found that frequent TABS users did not perform better than less frequent users on the detailed weather test although they did appear to take less time to brief themselves. This finding suggests that experience in using TABS may not produce substantial improvements in the amount of information pilots have after a briefing. It may be useful to provide pilots with feedback on their performance or to develop training materials that help pilots use TABS more effectively.

5.3 Explanation of the experimental findings

Taken together, the results from the experiment suggest that pilots using the simulated TABS system get an accurate idea about general weather conditions but do not have as much detailed information about the weather as pilots who are given the audio-taped briefing. In our view, this difference occurs because the information on TABS has not been tailored to the needs of the particular pilot, both in terms of the intended flight and in terms of the aircraft's VFR/IFR capability. Thus, pilots using TABS must make an extra effort to select and remember the relevant information. This is the most likely explanation for the results of this study. Although there are a number of alternative explanations that cannot be discounted, they are not strongly supported. These alternative explanations are discussed in the next section.

5.4 Alternative explanations of the experimental findings

One alternative explanation of lower performance in the TABS condition is that this condition demands a higher level of meterological expertise than the tailored briefing condition. The absence of an expert to interpret weather information for the pilot may well make it more difficult to use TABS.

This alternative explanation cannot be discounted, but it is not supported by a closer analysis of the study results. Although the number of pilots in the study is rather small, there is no evidence that pilots with relatively strong meteorological expertise perform better after using TABS than pilots with less expertise.

Another possible explanation of the lower performance in the TABS condition is that pilots find it more difficult to process information that they see depicted graphically than they do when they hear the information. Audio versus visual modality is certainly a noteworthy difference between the TABS condition and the tailored condition. Some support for this explanation can be found in a study of map reading by Thorndyke and Stasz (1980) who found that people with low ability to remember spatial information have difficulty recalling information depicted on maps. Furthermore, this difficulty was found even for people having considerable experience with maps.

This alternative explanation cannot be discounted at this point. However, we do not favor the explanation for two reasons. 1) Pilots tend to use maps when planning their flights. This task would appear easier with TABS, which indicates the location of weather conditions using a map-based display. 2) Results from the TABS User Survey indicated that most pilots rate the capability of TABS to display graphics and maps as a positive feature of the service.

In addition, the importance of modality is not supported by a closer examination of the study results. The modality explanation would predict that pilots using TABS would have difficulty understanding general weather conditions (which are depicted on maps) but would have no difficulty understanding detailed weather conditions depicted using text in the SA/FT pages. In fact, the opposite pattern of results was obtained.

Another possible reason that pilots in the TABS condition do worse on the detailed weather test is that they may have some difficulty

understanding the SA/FT pages. These pages contain the most detailed, up-to-date information about weather conditions at airports and operational data indicate that they are requested more frequently than any other page (about 30% of all requests). For pilots to understand these pages, they must know the abbreviations used and the standard order in which this information is presented. If this understanding is limited, they could do worse on the detailed weather test than pilots in the tailored condition, where the SA/FT information is given in plain English.

To examine this possibility, a follow-up experiment was conducted in which pilots were given information from the SA/FT pages used in the previous study. Each pilot was shown 8 SA/FT pages, which were the SA/FT pages for the takeoff and destination airports on each of the 4 weather days. Pilots were asked to describe the ceiling, visibility, wind, and other relevant weather while looking at each SA/FT page.

Results were straightforward and indicate that although there is some difficulty reading the SA/FT pages, pilots inability to interpret SA/FT pages would not account for the findings in the previous experiment. Using the scoring scheme developed in the previous experiment, pilots scored an average of 88%. Scores ranged from minimum of 75% to a maximum of 100%, or substantially higher than the 43% obtained in the experiment.

To conclude, pilots can read information from SA/FT pages with fairly high proficiency, although an error rate of 12% with the page available is of concern, because these pages are so frequently read. It is also possible that some pilots do not typically spend the time or

effort required to accurately interpret these pages. For this reason and because of how frequently pilots use information from these pages, improved ways of presenting the information on the SA/FT pages should be investigated.

6.0 Summary and future considerations

This report presents results of an experimental study comparing the performance of pilots who brief themselves using a simulated TABS system with pilots who receive an audiotape briefing tailored to their needs. Study findings indicate that pilots using either briefing system make go/no go decisions that agree reasonably well with those of an expert pilot. However, pilots using the simulated TABS system do not have as much detailed weather information relevant to their intended (hypothetical) flight. These findings suggest two possible conclusions: pilots who use TABS before flying may be making effective go/no go decisions, but they may not have all the detailed weather information they require to effectively plan or execute their flight. The most likely explanation for this latter possibility would be that pilots have difficulty in selecting and/or remembering information relevant to their intended flight when they brief themselves.

This conclusion is tentative, and further research would clarify the implications of making TABS available to pilots. Nevertheless, the study findings do suggest three future considerations. If pilots who use TABS have difficulty selecting and/or remembering information relevant to their flight, it would seem that improved briefings may be possible through some combination of the following: automatic selection of information relevant to the flight, availability of a paper copy of TABS pages as a memory aid, and improved training in the use of TABS. (It was previously suggested that consideration be given to improving the way information is presented on SA/FT pages.)

Pilot performance with TABS could possibly be enhanced by including

a tailored briefing option on TABS. By asking a pilot the type of flight (VFR/IFR), the type of aircraft, the estimated departure and arrival times, and the takeoff and destination airports, TABS could prepare a tailored briefing. Potential advantages of such a feature include:

- Pilots may come away from such a briefing with a more detailed understanding of the relevant weather conditions.
- Pilots can be briefed more quickly because they will spend less time reading information irrelevant to their flight and will not spend their time deciding what information is required for their flight.

The results of the TABS User Survey indicate that tailored briefings would encourage more frequent use of TABS.

Another potential TABS enhancement would be the availability of paper copies of information pages. These copies could serve as a memory aid both for pre-flight and in-flight planning and decision making.

A third approach that may improve pilot performance with TABS would be to ensure that pilots receive better training in the use of the system. One method of delivering instruction to pilots would be through the use of computer-assisted instruction (Nievergelt, 1980).

There are a number of reasons why using computer-assisted instruction may be an effective approach: 1) It may improve the competence of pilots generally as well as their performance when using TABS. 2) The TABS User Survey indicates that the system is already being used informally for instructional purposes. 3) It may be effective in introducing pilots to TABS. 4) It may provide a relatively inexpensive way of reaching a geographically dispersed group of pilots, either by using

hardware (TABS equipment) that has already been purchased, or by using microcomputer-based TABS simulators.

7.0 References

Transport Canada. Aviation weather information services course reference for aviation weather briefing techniques. Meteorology Training Centre, 1981.

Nievergelt, J. A pragmatic introduction to courseware design. IEEE Computer, September, 1980, 7-21.

Thorndyke, P. W., & Stasz, C. Individual differences in procedures for knowledge acquisition from maps. Cognitive Psychology, 1980, 12, 137-175.

Table 1

Comparison of Participants in Experiment with 1983 Transport Canada Statistics

Pilot characteristic		Percentage of pilots	
		Experiment (N = 40)	Transport Canada
A.	Sex		
	Female	5	6
	Male	95	94
	Total	100	100

X^2 (1) = 0.07, n.s.

		Experiment	Transport Canada
B.	Age		
	under 25	44	18
	25 - 35	43	37
	36 - 45	5	25
	over 45	8	20
	Total	100	100

X^2 (3) = 26.06, $p < 0.001$

		Experiment	Transport Canada
C.	License type		
	Student pilot	20	22
	Private pilot	15	56
	Commercial pilot	43	13
	A.T.R.	22	9
	Total	100	100

X^2 (3) = 46.96, $p < 0.001$

Table 2

Comparison of Aircraft Used by Pilots in Experiment with 1983 Transport Canada Statistics

Aircraft characteristic	Percentage of pilots Experiment	Transport Canada
A. Takeoff weight (kg)		
2,000 and under	57	48
2,001 - 4,000	23	11
4,001 - 5,670	8	8
5,671 - 18,000	12	5
over 18,000	0	28
Total	100	100

X^2 (4) = 21.28, $p < 0.001$

	Experiment	Transport Canada
B. Source of propulsion		
Piston	95	54
Turboprop	5	12
Jet	0	27
Other	0	7
Total	100	100

X^2 (3) = 27.69, $p < 0.001$

Table 3

Go/No Go Decision as a Function of Weather Day and Type of Briefing

	Weather Day			
	1 No go	2 Go	3 Go	4 Marginal
TABS briefing	1.4[1] (0.9)[2]	3.4 (0.9)	3.4 (0.9)	2.4 (0.9)
Tailored briefing	1.6 (0.5)	3.2 (0.4)	3.8 (0.4)	2.8 (1.3)

Weather day: $F(3,32) = 12.49$, $p < 0.001$

Briefing: $F(1,32) = 0.57$, n.s.

Weather day x Briefing: $F(3,32) = 0.29$, n.s.

[1]Average score of ratings: 1 = definitely not; 2 = probably not; 3 = probably would; 4 = most definitely would.

[2]Standard deviations in brackets.

Table 4

Performance on Weather Information Test Against Weather Day and Type of Briefing

	Weather Day 1 No go	2 Go	3 Go	4 Marginal	Average
TABS briefing	0.39[1] (41)[2]	0.58 (46)	0.37 (36)	0.33 (14)	0.40
Tailored brief.	0.78 (34)	0.69 (43)	0.72 (17)	0.62 (42)	0.70
Average	0.58	0.64	0.47	0.47	

Weather day: $F(3,32) = 1.3$, n.s.

Briefing: $F(1,32) = 24.9$, $p < 0.001$

Weather day x Briefing: $F(3,32) = 1.2$, n.s.

[1]Total score achieved divided by possible score of 196.

[2]Standard deviations of absolute frequencies in parentheses.

Table 5

Average Performance Scores for TABS and Tailored Briefings for each Question

Question	TABS	Tailored	Total Possible Score	t test	Stat. Sig.
Was there a Sigmet?	6.3 (1.9)	5.3 (2.8)	7	1.4	n.s.
Current weather at departure airport	15.0 (10.9)	29.2 (8.7)	35	4.6	$p < 0.001$
Current weather en route	14.5 (11.9)	18.4 (10.1)	35	1.1	n.s.
Current weather at destination	14.8 (9.2)	27.6 (7.9)	35	4.7	$p < 0.001$
Expected weather at destination	9.6 (9.8)	20.4 (11.6)	35	3.2	$p < 0.01$
Discrepancies in weather information	5.6 (2.4)	4.7 (3.3)	7	0.9	n.s.
Wind at flight planned altitude	2.5 (4.1)	2.9 (3.5)	7	0.4	n.s.
Describe relevant Notams	1.0 (2.2)	6.3 (2.2)	7	7.6	$p < 0.001$
Describe relevant Pireps	2.4 (3.4)	6.3 (2.2)	7	4.3	$p < 0.001$
If ceiling expected, describe	5.3 (3.1)	5.6 (2.9)	7	0.4	n.s.
Freezing level altitude	2.5 (2.9)	5.5 (2.9)	7	3.3	$p < 0.01$
Describe any turbulence expected	2.1	6.0	7	5.0	$p < 0.001$

Table 6

Time Taken to Obtain a Weather Briefing as a Function of Weather Day and Type of Briefing

	Weather day				
	1 No go	2 Go	3 Go	4 Marginal	Average
TABS briefing	29.0[1] (17.2)[2]	30.4 (6.7)	24.6 (5.2)	35.2 (17.9)	29.8
Tailored brief.	17.6 (5.0)	18.2 (9.2)	12.2 (1.6)	21.8 (14.0)	17.4
Average	23.3	24.3	18.4	28.5	

Weather day: $F(3,32) = 1.38$, n.s.

Briefing: $F(1,32) = 12.24$, $p < 0.001$

Weather day x Briefing: $F(3,32) = 0.01$, n.s.

[1]Average time in minutes.

[2]Standard deviation in parentheses.

Table 7

Performance on Weather Information Test
as a Function of Expertise and Frequency of TABS Use
in the TABS Briefing Condition

		Expertise	
		Low	High
Frequency	Low	0.42 (6,24)[1]	0.43 (3,30)
	High	0.42 (3,1)	0.41 (8,9)

Frequency: $F(1,16) = 0.87$, n.s.

Expertise: $F(1,16) = 0.01$, n.s.

Frequency X Expertise: $F(1,16) = 0.02$, n.s.

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[1]The first number denotes the number of subjects; the second number is the standard error.